US 20020099875A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2002/0099875 A1

Locklear et al. (43) Pub. Date: Jul. 25, 2002

(54) SYSTEM AND METHOD FOR CONFIGURING AN I/O BUS

(75) Inventors: **David A. Locklear**, Austin, TX (US); **Michael A. Wright**, Round Rock, TX (US)

Correspondence Address:
Robert W. Holland
Baker Botts L.L.P.
One Shell Plaza
910 Louisiana
Houston, TX 77002-4995 (US)

(73) Assignee: **DELL PRODUCTS L. P.**

(21) Appl. No.: **09/769,799**

(22) Filed: **Jan. 25, 2001**

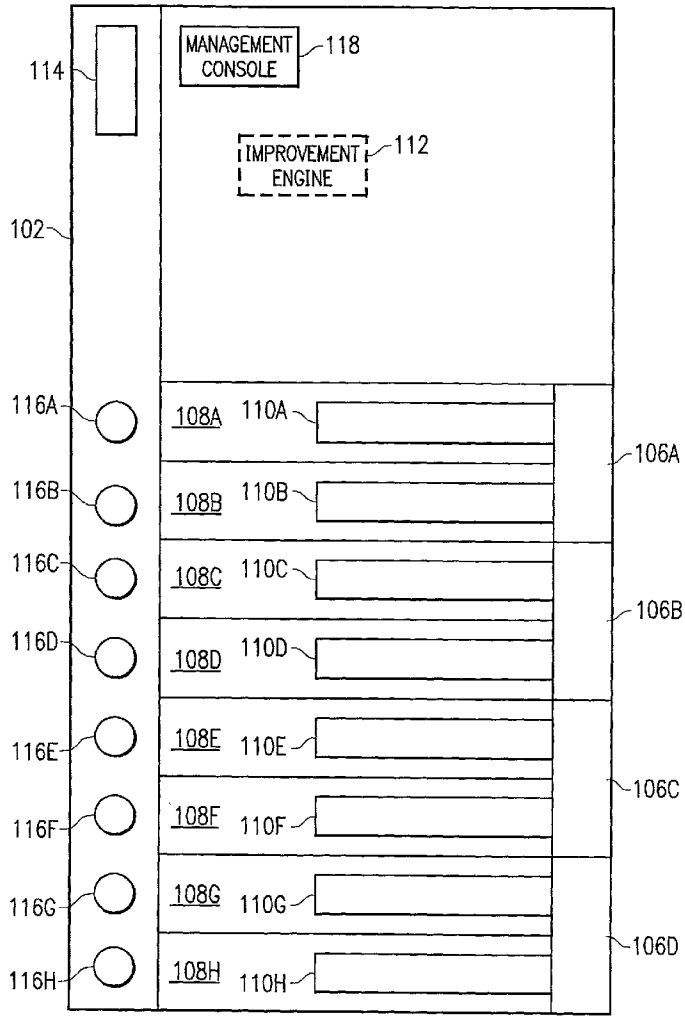
Publication Classification

(51) **Int. Cl.**[7] **G06F 3/00**

(52) **U.S. Cl.** **710/2**

(57) **ABSTRACT**

A system and method are provided for configuring an I/O bus. The system and method includes a plurality of adapter cards. A plurality of adapter card slots associated with the I/O busses receive the adapter cards into the computer. A user initiates optimization to check for configuration optimization problems and more specifically to check the placement of the adapter cards within the adapter card slots of the I/O busses. The user initiates optimization and in turn activates the improvement engine within the computer. The improvement engine analyzes the data transfer rates of the I/O busses and adapter cards and the placement of the adapter cards to determine an improved configuration of the adapter cards within the I/O busses. Indicators located proximate to the I/O busses display visual indication regarding the adapter card placement within the I/O busses allowing the user to determine if the configuration can be improved.



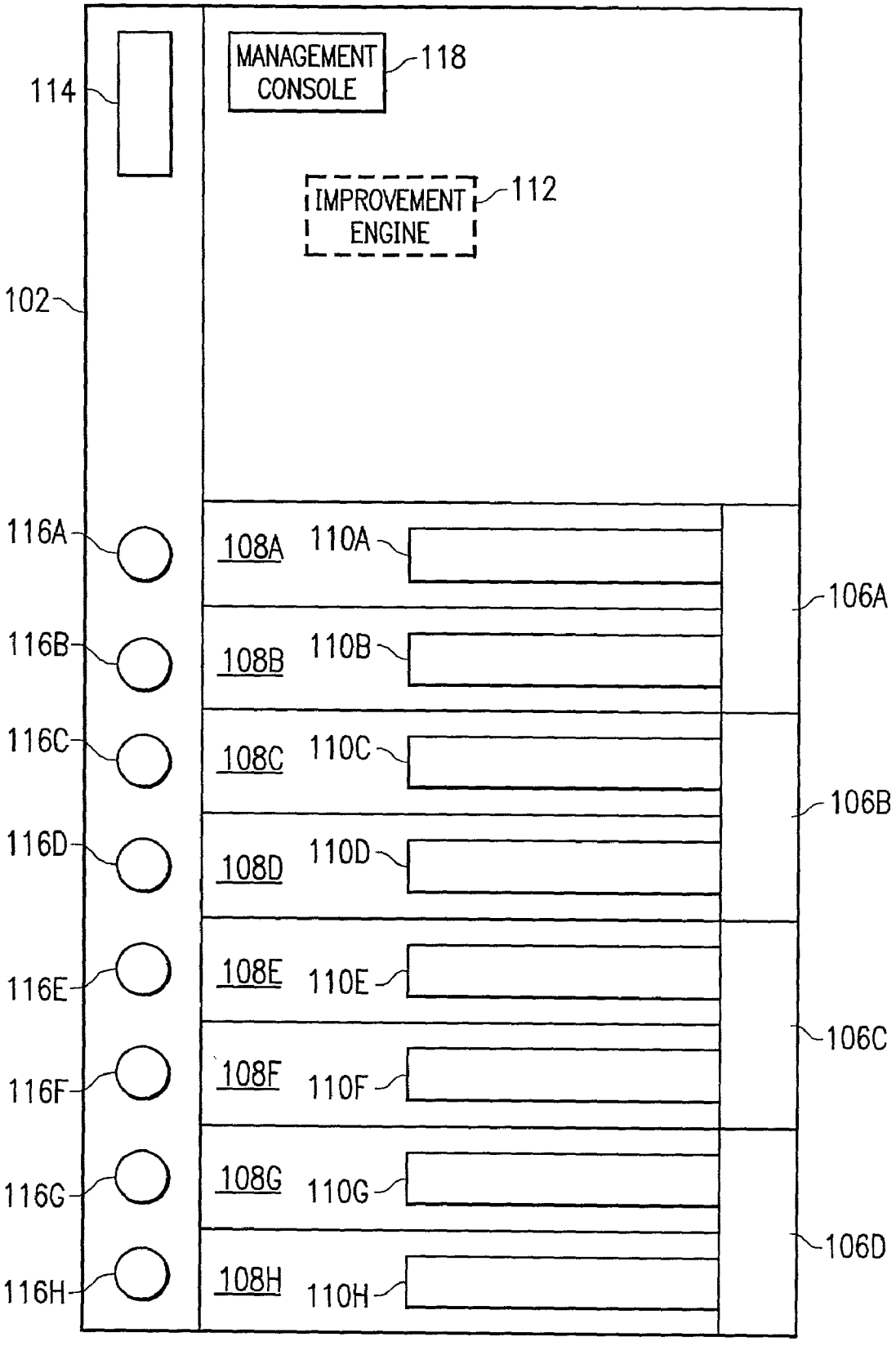

MANAGEMENT CONSOLE
118
114
IMPROVEMENT ENGINE
112
102
116A
116B
116C
116D
116E
116F
116G
116H
108A
110A
108B
110B
108C
110C
108D
110D
108E
110E
108F
110F
108G
110G
108H
110H
106A
106B
106C
106D

FIG. 1

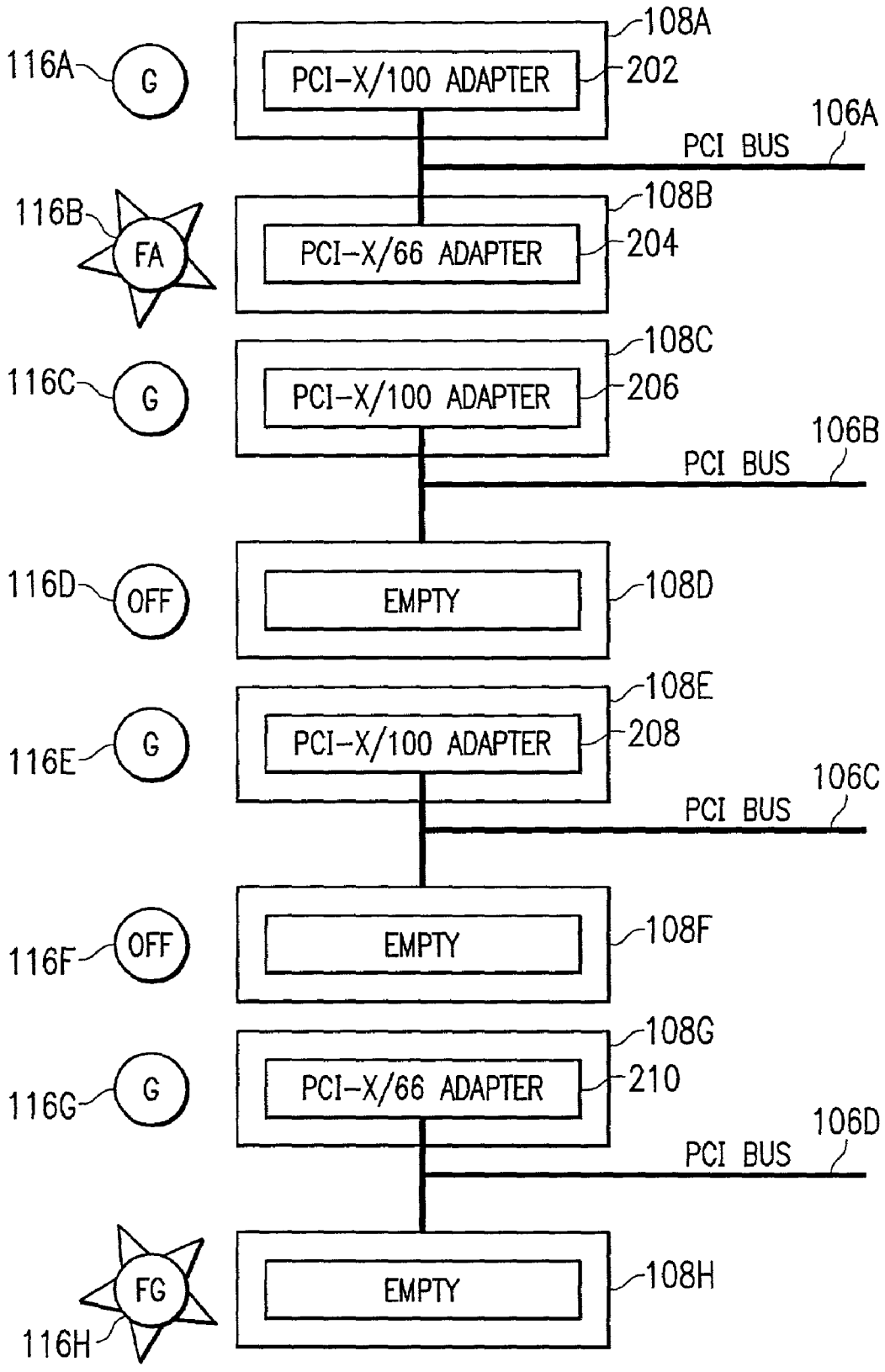

116A
G
PCI-X/100 ADAPTER
108A
202
106A
PCI BUS
116B
FA
PCI-X/66 ADAPTER
108B
204
116C
G
PCI-X/100 ADAPTER
108C
206
106B
PCI BUS
116D
OFF
EMPTY
108D
116E
G
PCI-X/100 ADAPTER
108E
208
106C
PCI BUS
116F
OFF
EMPTY
108F
116G
G
PCI-X/66 ADAPTER
108G
210
106D
PCI BUS
FG
116H
EMPTY
108H

FIG. 2

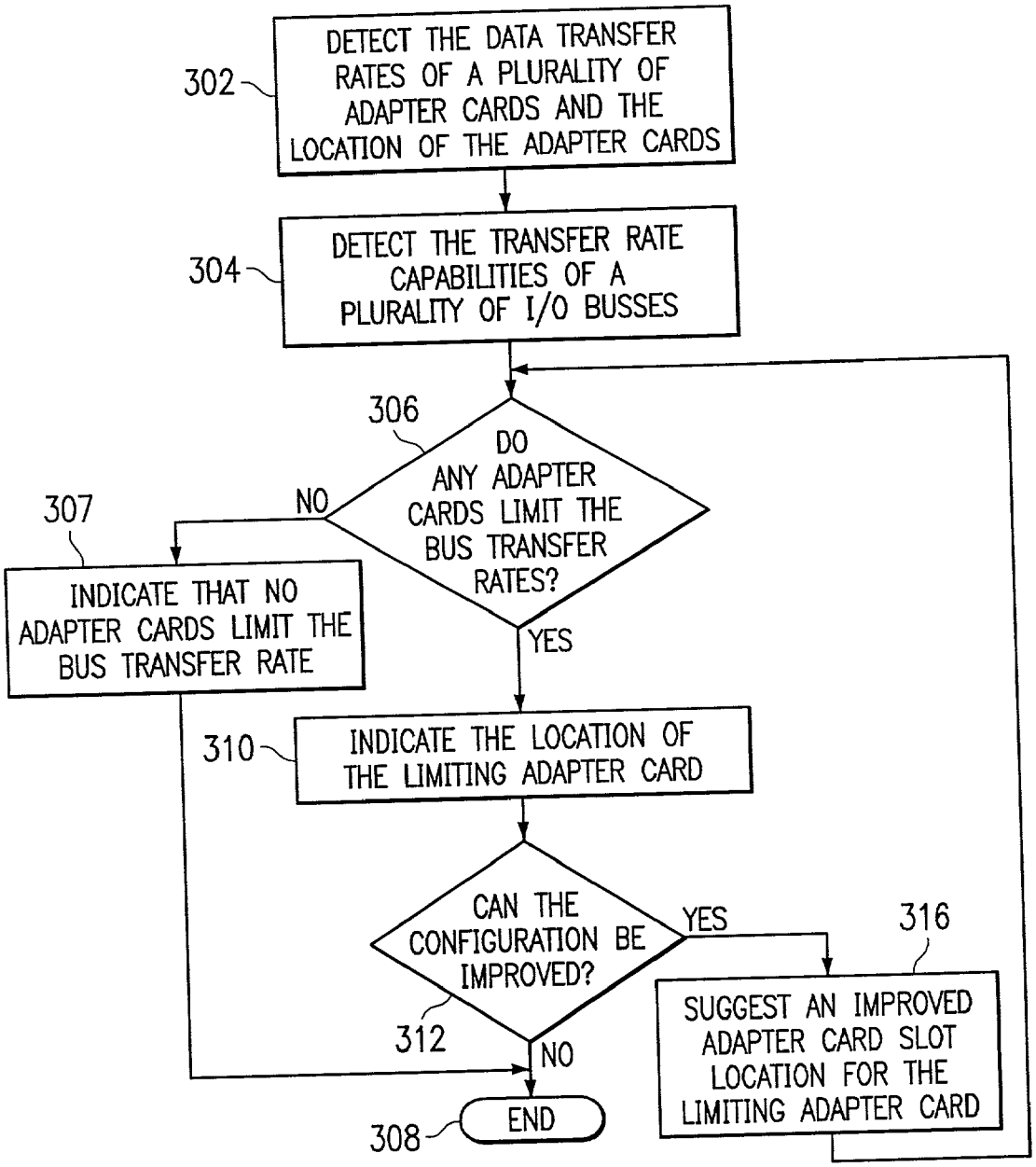

302
DETECT THE DATA TRANSFER RATES OF A PLURALITY OF ADAPTER CARDS AND THE LOCATION OF THE ADAPTER CARDS
304
DETECT THE TRANSFER RATE CAPABILITIES OF A PLURALITY OF I/O BUSSES
306
DO ANY ADAPTER CARDS LIMIT THE BUS TRANSFER RATES?
NO
307
INDICATE THAT NO ADAPTER CARDS LIMIT THE BUS TRANSFER RATE
YES
310
INDICATE THE LOCATION OF THE LIMITING ADAPTER CARD
CAN THE CONFIGURATION BE IMPROVED?
YES
316
SUGGEST AN IMPROVED ADAPTER CARD SLOT LOCATION FOR THE LIMITING ADAPTER CARD
312
NO
308
END

FIG. 3

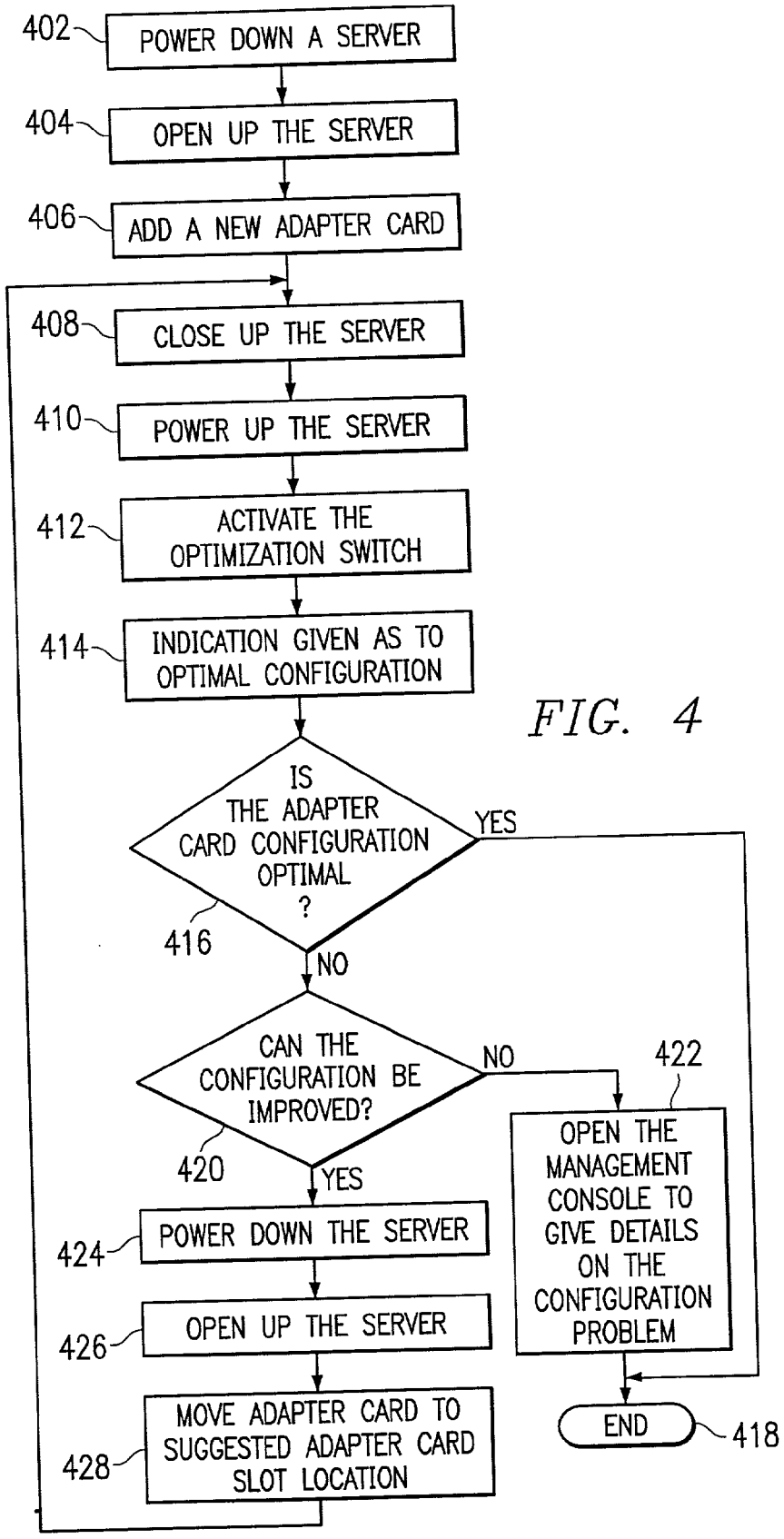

402
POWER DOWN A SERVER
404
OPEN UP THE SERVER
406
ADD A NEW ADAPTER CARD
408
CLOSE UP THE SERVER
410
POWER UP THE SERVER
412
ACTIVATE THE OPTIMIZATION SWITCH
414
INDICATION GIVEN AS TO OPTIMAL CONFIGURATION
IS THE ADAPTER CARD CONFIGURATION OPTIMAL ?
YES
416
NO
CAN THE CONFIGURATION BE IMPROVED?
NO
422
420
YES
OPEN THE MANAGEMENT CONSOLE TO GIVE DETAILS ON THE CONFIGURATION PROBLEM
424
POWER DOWN THE SERVER
426
OPEN UP THE SERVER
428
MOVE ADAPTER CARD TO SUGGESTED ADAPTER CARD SLOT LOCATION
END
418

FIG. 4

SYSTEM AND METHOD FOR CONFIGURING AN I/O BUS

BACKGROUND

[0001] Personal computers and servers are generally designed with multiple input/output (I/O) busses with the I/O busses accommodating one or more plug-in adapter cards. An I/O bus is the data path on a computer's motherboard that interconnects the microprocessor with adapter cards in expansion or adapter card slots and allows the adapter cards to access the microprocessor and memory. The plug-in adapter cards allow for easy installation of added capabilities such as video, audio, and communications. The I/O bus allows for data to be exchanged between the computer processor and the peripheral and regulates the speed at which data is exchanged.

[0002] As the specifications for I/O busses have evolved, I/o busses support higher date transfer rates. In order to take advantage of the higher data transfer rates, both the I/O busses and the adapter cards must support the higher data transfer rates. However to support compatibility with older adapter cards that do not support the higher data transfer rates, an architected method exists whereby the I/O bus and the adapter card negotiate for the highest supported data transfer rate. Therefore to accommodate slower adapter cards, an I/O bus with multiple adapter card slots transfers data at a data transfer rate equal to the slowest adapter card on the I/O bus. If a user adds an adapter card to a bus already containing an adapter card and the adapter cards are of varying data transfer rates, then performance of the computer system suffers because the two adapter cards will not operate at each card's maximum data transfer rate but instead at the slower of the two maximum data transfer rates of the adapter cards.

[0003] A similar problem also occurs when multiple adapter cards of the same data transfer rate are located on one I/O bus when there are unoccupied I/O busses available in the computer system. Because the adapter cards operate at the same data transfer rate, the adapter cards will operate at their maximum data transfer rate. But the adapter cards have to share the total available bandwidth of the single I/O bus while the other I/O busses go unused or underused. Thereby the computer system does not operate as efficiently as it could if the adapter cards were located on separate I/O busses.

[0004] Because adapter cards and I/O busses auto-negotiate the data transfer rate to accommodate slower adapter cards on the same I/O bus, many users are not operating their computer systems at optimal or efficient levels. But configuring a computer system to operate at an optimal or even improved level is a difficult task for a majority of users. Improving the configuration of computer systems typically involves running a diagnostic on the system by someone having some degree of knowledge with computers. Indeed, even recognition that a configuration needs improving generally involves a degree of expertise. Moreover, improving a configuration requires the user to consult the user's manual on how best to configure adapter cards to achieve optimum or improved performance. If a user upgrades or has third party components within the computer system, then the user must also obtain the performance specifications for those third party components in order to improve the configuration. Therefore, improving a configuration is neither an intuitive task nor a user friendly task. Also, consumers who spend extra money to purchase advanced computer systems often do not know if the configuration is operating sub-optimally and therefore may not get as good a return as they should on their investment in the computer system.

[0005] Another difficulty in improving a configuration is that telephone servicing and technical support of computer systems for configuration problems is difficult. Non-optimized configurations cause problems in a computer system but most users are unaware that the placement of adapter cards can cause configuration problems as well as other problems. Trying to determine over the telephone the problem with a computer system is a difficult task even when the user has an idea of the problem. And without being able to physically see the computer system, the technical support staff has a hard time fixing a configuration optimization problem without the user having at least some knowledge of I/O busses and adapter cards.

SUMMARY

[0006] Therefore, a need has arisen for a system and method that visually indicates configuration problems and solutions for I/O busses.

[0007] A further need has arisen for a system and method that allows a user to achieve an optimal or improved configuration without specialized knowledge.

[0008] A further need has arisen for a system and method that allows for the servicing of configuration problems over the telephone.

[0009] In accordance with teachings of the present disclosure, a system and method are described for configuring an I/O bus which substantially eliminates or reduces disadvantages and problems associated with previous systems and methods. The system and method allows for an intuitive and uncomplicated way for a user to recognize and resolve I/O bus or adapter card configuration optimization problems.

[0010] In accordance with one aspect of the present disclosure, a system and method provides visual indication of I/O bus configuration optimization problems and solutions. A computer has a plurality of adapter cards. A user inserts the adapter cards into adapter card slots interfaced with the I/O busses of the computer. The user presses an optimization switch, located on the computer, to check the current adapter card configuration. Pressing the optimization switch activates an improvement engine within the computer to analyze the I/O busses and the adapter cards to determine an improved configuration of the adapter cards within the adapter card slots of the I/O busses. Indicators located on the computer and proximate to the adapter card slots display visual indication on whether or not the adapter card placement within the I/O busses is an optimal configuration.

[0011] More specifically, the improvement engine detects the data transfer rates for the adapter cards and the transfer rate capabilities of the I/O busses. When the user initiates optimization, the improvement engine analyzes and compares the data transfer rates of the installed adapter cards with the transfer rate capabilities of the I/O busses to determine if any of the installed adapter cards limit the I/O bus transfer rates. If an adapter card limits an I/O bus transfer rate, the improvement engine activates the indicator

associated with the adapter card slot of the I/O bus receiving the adapter card to visually indicate that this particular adapter card limits the I/O bus transfer rate. In addition, the improvement engine determines where the limiting adapter card should be placed within the plurality of I/O busses so that the adapter card has a reduced impact on the I/O bus transfer rate. The improvement engine also activates the indicator associated with the adapter card slot of the I/O bus where the adapter card should be placed so as to improve the I/O bus transfer rate. Therefore, the user can see what adapter card limits the transfer rate and where to move the adapter card to improve the configuration.

[0012] The present disclosure provides a number of important technical advantages. One important technical advantage is that the system and method provides to the user visual indication regarding configuration optimization problems. The visual indication allows a user to recognize and improve upon the optimization problems. Even users who would never think to check their computer's configuration of adapter cards within the adapter card slots or suspect a configuration problem can now get a visual indication of a configuration problem by initiating optimization. In addition, the ability to visually recognize and correct configuration problems adds value to users' computers because users know that their system is running at an optimal level where before they typically did not even know that they had a problem. Therefore, users get their money's worth from their computers as well as any high dollar adapter cards installed in the computer.

[0013] Another important technical advantage of the present disclosure is that recognizing and correcting I/O bus adapter card slot configuration optimization problems is an intuitive and user friendly task. A user with little computer knowledge can quickly test for a configuration optimization problem by activating optimization and if a non-optimal I/O bus adapter card slot configuration problem exists, quickly correct it by making any recommended changes. The user can check the configuration immediately after power up and prior to booting the operating system and running any management software. Therefore, any configuration problems are discovered and resolved quickly. Users no longer have to consult user's manuals or search for the specifications for third party components in order to be able to recognize and correct configuration optimization problems. In addition, users can upgrade their systems without worrying about changing an otherwise optimized configuration because activating optimization tells the users if they have optimally installed a new adapter card.

[0014] Another important technical advantage of the present disclosure is that it simplifies servicing by telephone. If a technical support staff suspects that an I/O bus adapter card slot configuration problem causes a user's overall problem, the technical support staff can tell the user to activate optimization and the user can quickly report back to the technical support staff what the indicators display. The technical support staff can determine if there is an optimization configuration problem from what the indicators display. Therefore, users unaware of configuration problems, adapter cards, and I/O busses and having problems associated with any of these items can have these problems adequately addressed with servicing over the telephone.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] A more complete understanding of the present embodiments and advantages thereof may be acquired by referring to the following description taken in conjunction with the accompanying drawings, in which like reference numbers indicate like features, and wherein:

[0016] **FIG. 1** depicts a block cutaway diagram of the hardware components for the visual indication of I/O bus adapter card slot configuration optimization problems and solutions system for a server;

[0017] **FIG. 2** depicts a block diagram of the indicators, adapter cards, adapter card slots, and I/O busses of the system shown in **FIG. 1**;

[0018] **FIG. 3** depicts a flow diagram for improving the configuration of adapter cards; and

[0019] **FIG. 4** depicts a flow diagram for employing the system and method to visually indicate configuration optimization problems and solutions.

DETAILED DESCRIPTION

[0020] Preferred embodiments and their advantages are best understood by reference to **FIGS. 1 through 4**, wherein like numbers are used to indicate like and corresponding parts.

[0021] **FIG. 1** depicts a block cutaway diagram of the rear view of the hardware components for the visual indication of I/O bus adapter card slot configuration optimization problems and solutions system for server **102**.

[0022] Server **102** has four input/output (I/O) busses: I/O bus **106**A, I/O bus **106**B, I/O bus **106**C, and I/O bus **106**D. In alternative embodiments, server **102** may contain more than four or less than four I/O busses. I/O busses **106** contain two adapter card slots **108** per I/O busses **106**. I/O bus **106**A contains adapter card slots **108**A and **108**B, I/O bus **106**B has adapter card slots **108**C and **108**D, I/O bus **106**C contains adapter card slots **108**E and **108**F, and I/O bus **106**D has adapter card slots **108**G and **108**H. In alternative embodiments, I/O busses **106** may contain less than two or more than two adapter card slots per bus.

[0023] I/O busses **106** comprise peripheral component interconnect (PCI) bus type, peripheral component interconnect extended (PCI-X) bus type, or any other appropriate bus type. The PCI-X bus type allows server **102** to support new PCI-X cards as well as PCI adapter cards. PCI-X is a newer bus technology that increases the data transfer rate from 66 MHz, the maximum for PCI busses, to 133 MHz. In addition, PCI-X is also backwards compatible and therefore allows server **102** to run PCI adapter cards in a PCI-X bus.

[0024] Adapter card slots **108**, associated with I/O busses **106**, accept adapter cards **110**. The type of adapter cards **110** that server **102** accepts include adapter card types such as PCI and PCI-X. In addition, adapter cards **110** increase the capabilities of server **102** by adding such functions as RAID controllers, video adapters, graphic accelerators, sound cards, modems, accelerator boards, LAN cards (such as 10/100 MBs Ethernet network interface cards), SCSI cards, and WAN cards. Each of the adapter card slots **108** receives one of the adapter cards **110**. Adapter card slot **108**A receives adapter card **110**A, adapter card slot **108**A receives

adapter card **110**B, adapter card slot **108**C receives adapter card **110**C, adapter card slot **108**D receives adapter card **110**D, adapter card slot **108**E receives adapter card **110**E, adapter card slot **108**F receives adapter card **110**F, adapter card slot **108**G receives adapter card **110**G, and adapter card slot **108**H receives adapter card **110**H.

[**0025**] Improvement engine **112**, associated with I/O busses **106** and server **102**, operates to improve the placement of adapter cards **110** within I/O busses **106**. Improvement engine **112** is a programmable logic device or ASIC that is designed for the special application of recognizing configuration optimization problems and providing configuration optimization solutions. Alternatively, improvement engine **112** may be implemented as software on a microprocessor. Improvement engine **112** is built into the system board of server **102** and detects the maximum capable data transfer rates of both adapter cards **110** and I/O busses **106**. Improvement engine **112** detects or the specific I/O architecture of server **102** including which adapter card slots **108** are associated with I/O busses **106**. In addition, improvement engine **112** also detects the transfer rate capabilities of I/O busses **106**. Improvement engine **112** also detects the maximum transfer capabilities of adapter cards **110** by sampling signals on the interface of adapter cards **110** as defined by the I/O bus architecture. Improvement engine **112** determines when the inclusion of an adapter card **110** on a certain I/O bus **106** brings down the bus transfer rate and consequently negatively impacts the data transfer rates of the other adapter card **110** on the particular I/O bus **106**. For example, if adapter card **110**A operates at 100 MHz and adapter card **110**B operates at 66 MHz, adapter card **110**B limits the operation of adapter card **110**A to 66 MHz since adapter cards **110**A and **110**B are on the same I/O bus **106**A and must operate at the same speed. In addition, improvement engine **112** also determines if another adapter card slot **108** within server **102** is an improved location for adapter card **110** in order to prevent performance and optimization problems.

[**0026**] Optimization switch **114**, associated with improvement engine **112** and server **102**, allows the user servicing or configuring server **102** to request visual indication on the current adapter card **110** configuration. In order to provide visual indication, server **102** takes advantage of indicators **116**A through **116**H associated with adapter card slots **108** and I/O busses **106**. Indicators **116** are bicolor, light emitting diodes (LED). Server **102** typically uses indicators **116** for PCI hot plug identification so that when not testing for optimization, indicators **116** provide an indication to the user of server **102** on whether an adapter card **110** within adapter card slot **108** is powered, failed, or ready for a hot plug operation. When the user depresses optimization switch **114**, indicators **116** convert from their PCI hot plug system identification function and instead are used to indicate the optimization of the placement of adapter cards **110** within the adapter card slots **108** and I/O busses **106**. Each indicator **116** is associated with a single adapter card slot **108** and returns visual indication only for the adapter card **110** in that adapter card slot **108**. For example, indicator **116**A returns optimization information regarding adapter card **110**A, indicator **116**B returns information regarding adapter card **110**B and so forth.

[**0027**] Indicators **116** denote four different states in relation to adapter card slots **108**. Indicator **116** unlit indicates that no adapter card is present within adapter card slot **108**. Indicator **116** that is a steady green indicates that adapter card **110** located in adapter card slot **108** does not limit the data transfer rate. Indicator **116** flashing amber indicates that adapter card **110** located in that adapter card slot **108** limits the bus transfer rate causing the configuration to not be optimized. Indicator **116** flashing green gives the indication of where the adapter card **110** limiting the configuration should be moved in order to improve the data transfer rate.

[**0028**] If the configuration cannot be improved there will be no indicators **116** flashing green, and the user can access and bring up management console **118**, associated with improvement engine **112**, to view details regarding the status of the configuration of adapter cards **110** within adapter card slots **108**.

[**0029**] **FIG. 2** depicts a block diagram of indicators **116**, adapter card slots **108**, and I/O busses **106** of server **102** shown in **FIG. 1**. Server **102** contains four independent I/O busses **106** with two adapter card slots **108** per I/O bus **106**. For exemplary purposes, all four I/O busses **106** are shown in **FIG. 2** as PCI-X busses with two adapter card slots **108** per bus and support adapter cards running at 100 MHz, 66 MHz and 33 MHz.

[**0030**] **FIG. 2** shows a 100 MHz adapter card **202** plugged into adapter card slot **108**A, a 66 MHz adapter card **204** plugged into adapter slot **108**B, a 100 MHz adapter card **206** plugged into adapter card slot **108**C, a 100 MHz adapter card **208** plugged into adapter card slot **108**E, and a 66 MHz adapter card **210** plugged into adapter card slot **108**G. Adapter card slots **108**D, **108**F, and **108**H do not contain any adapter cards and are therefore left empty.

[**0031**] The user of server **102** desires to check to see if the configuration of the adapter cards **202**, **204**, **206**, **208** and **210** is an optimal configuration. Therefore, the user depresses optimization switch **114**. When the user presses optimization switch **114**, improvement engine **112** detects whether or not an adapter card **110** is in an adapter card slot **108**, and then determines the data transfer rates of adapter cards **202** through **210** and the I/O busses **106**.

[**0032**] When the user presses optimization switch **114**, indicators **116** produce visual indication regarding configuration optimization. Indicators **116**D and **116**F remain a steady off because adapter card slots **108**D and **108**F have no adapter cards. Indicators **116**A, **116**C, **116**E, and **116**G are steady green indicating that adapter cards **202**, **206**, **208**, and **210**, respectively, do not limit the data transfer rate. Indicator **116**B flashes amber indicating that adapter card **204** limits the data transfer rate of bus **106**A. Adapter card **204** limits the data transfer rate of I/O bus **106**A because both adapter card slots **108**A and **108**B have adapter cards present. Since adapter cards **202** and **204** are on the same bus, adapter cards **202** and **204** must operate at the same clock speed. Adapter card **204** limits adapter card **202** because the maximum speed of 66 MHz of adapter card **204** limits the 100 MHz adapter card **204** to 66 MHz instead of its maximum speed of 100 MHz. Adapter card **204** limits adapter card **202** because adapter card **202** cannot operate at its optimal data transfer rate.

[**0033**] The configuration can be improved and indicator **116**H displays this. Indicator **116**H flashes green indicating that the user should move adapter card **204** to adapter card

slot **108**H in order to no longer limit the data transfer rate of I/O bus **106**A. Adapter card slot **108**H is the ideal location for adapter card **204** because adapter card slot **108**G already contains adapter card **210** running at 66 MHz. Adapter card **210** and adapter card **204** run at the same maximum clock speed, 66 MHz, and therefore adapter cards **204** and **210** operate at an optimum level and I/O bus **106**D operates at an optimal data transfer rate. Once the user moves adapter card **204** from adapter card slot **108**B to adapter card slot **108**H and activates optimization switch **114**, all indicators associated with adapter card slots **108** containing an adapter card are a steady green indicating that the configuration is optimized.

[**0034**] If the configuration cannot be optimized, indicators **116** show which adapter cards limit the configuration by flashing amber but not indicating an improved adapter card slot **108** location to switch the adapter card to. At this point, the user brings up management console **118** for more details on the configuration problem.

[**0035**] **FIG. 3** depicts a flow diagram for improving the configuration of adapter cards **110**. In step **302**, improvement engine **112** detects the data transfer rates of adapter cards **110** and also detects the location of adapter cards **110** within adapter card slots **108**. In step **304**, improvement engine **112** detects the transfer rate capabilities of I/O busses **106**.

[**0036**] Comparing and analyzing data transfer rates of adapter cards **110** with transfer rate capabilities of I/O busses **106**, improvement engine **112** determines whether any of adapter cards **110** limit the other adapter cards **110** located on the same I/O bus **106** in step **306**. If none of the adapter cards **110** limit the bus transfer rates, then in step **307** indicators **116** all flash green indicating that no adapter cards **110** limit the bus transfer rate. Therefore, the configuration cannot be improved upon, the user needs not act, and the process ends in step **308**. But if one or more adapter cards **110** limits the data transfer rates of other adapter cards **100** on I/O busses **106**, then in step **310**, improvement engine **112** determines a single adapter card **110** that limits the configuration. The process indicates one limiting adapter card **110** at a time in order to simplify the process for the user. Indicators **116** indicate the adapter card **110** that limits the configuration by flashing amber. After determining that the configuration is not optimized, in step **312** improvement engine **112** determines whether or not the configuration can be improved. If the configuration cannot be improved, improvement engine **112** does not suggest an adapter card slot **108** location for the limiting adapter card **110** and the process ends in step **308**.

[**0037**] But if in step **312** improvement engine **112** determines that the configuration can be improved, then in step **316** improvement engine **112** suggests an improved adapter card slot **108** location for adapter card **110** limiting the configuration by having indicator **116** flashing green for adapter card slot **108** location where the user should move adapter card **110** limiting the configuration. Once the user moves adapter card **110** limiting the configuration to the improved adapter card slot **108** location, improvement engine **112** again checks in step **306** to determine if any adapter cards **110** limit the data transfer rate. If no adapter cards **110** limit the data transfer rate in step **306**, then the configuration is optimized and the process ends in step **308**. If the configuration is still not optimized, the process repeats until the configuration is optimized or improvement engine **112** determines that moving additional adapter cards **110** will not affect the limited data transfer rate.

[**0038**] **FIG. 4** illustrates a flow diagram for how a user employs the system and method for visually indicating configuration optimization problems and solutions. **FIG. 4** depicts the process for when a user wants to add a new adapter card to a pre-existing configuration but the process also applies to configurations where a user is not adding any new adapter cards but only wants to check for optimization.

[**0039**] In step **402**, the user powers down server **102** and in step **404** the user opens up server **102** in order to access adapter card slots **108**. In step **406**, the user adds a new adapter card **110**. The user closes up server **102** in step **408** and powers up server **102** in step **410**.

[**0040**] In step **412**, the user activates optimization switch **114** to request visual indication on the configuration optimization. In step **414**, indicators **116** display the visual indication and give an indication to the user regarding the optimal configuration. The user reads the indication from indicators **116** in order to determine if the configuration is optimal in step **416**. If indicators **116** are a combination of steady green or steady off, then the configuration is optimized and the user needs not act further and the optimization process ends in step **418**.

[**0041**] If in step **416** indicators **116** are not all of a combination of steady green or steady off but one flashes amber, then the configuration is not optimal. So in step **420**, the user must look at indicators **116** to determine if the configuration can be improved. If one of the indicators **116** flashes amber and none of the other indicators flash green, then the configuration works as well as possible. Therefore, in step **422**, the user boots the operating system and brings up management console **118** to give the user details on the configuration problem. But if in step **420** the configuration can be improved, then one of the indicators **116** flashes amber while another of the indicators **116** flashes green. Therefore, the user will know where to move the identified adapter card **110** so that its limitation is minimal. In step **424** the user powers down server **102** and in step **426** opens up server **102** to gain access to adapter card **110** limiting the configuration. In step **428**, the user moves adapter card **110** that limits the configuration to the suggested improved adapter card slot **108** location to fix the optimization problem. The user then closes server **102** in step **408** and powers up server **102** in step **410**.

[**0042**] If optimization requires multiple adapter card **110** moves to obtain optical performance, the process is for improvement engine **112** to indicate one adapter card **110** move at a time in order to keep the process simple and intuitive. A user employs the process as shown in **FIG. 4** until the indicators **116** show that an optimal configuration is achieved. If it is not possible to configure adapter cards **110** in an optimal way, indicators **116** show which adapter card **110** limits the data transfer rate, but do not indicate a suggested adapter card slot **108** location in which to move adapter card **110** that limits the configuration. At this point, the user may access management console **118** to get details on the configuration problem.

[**0043**] Although the disclosed embodiments have been described with regard to adapter cards on separate I/O

busses, this system and method is applicable to any adapter card configuration problem that limits performance. For example, if two adapter cards are on the same bus while all other busses are left empty, then the data transfer rate of the I/O bus is potentially limited even if the adapter cards operate at the same maximum clock speed. The system and method address this limitation and indicate that the two adapter cards be on separate busses so that they no longer share the limited bandwidth of a single I/O bus, but have their own full amount of bandwidth on their own separate I/O bus. Therefore, there is less unused bandwidth allowing for improved performance. In addition, the system and method equally apply to all types of computers and not only to servers as described in the disclosed embodiment above.

[0044] Although the disclosed embodiments have been described in detail, it should be understood that various changes, substitutions and alterations can be made to the embodiments without departing from their spirit and scope.

What is claimed is:

1. A computer system comprising:

a plurality of adapter cards operable to interface with the computer system;

a plurality of adapter card slots interfaced with the adapter cards, the plurality of adapter card slots operable to receive the adapter cards;

a plurality of I/O busses associated with the adapter card slots, the plurality of I/O busses operable to interface with the adapters cards;

an improvement engine associated with the plurality of I/O busses, the improvement engine operable to measure I/O bus performance and improve the placement of the adapter cards within the plurality of adapter card slots; and

a plurality of indicators associated with the plurality of adapter card slots, the indicators operable to display visual indication on the adapter card configuration.

2. The computer system of claim 1 further comprising an optimization switch associated with the plurality of I/O busses and the improvement engine, the optimization switch operable to activate the improvement engine and the indicators.

3. The computer system of claim 1 wherein the indicators comprise bi-color LED's.

4. The computer system of claim 1 wherein the indicators comprise PCI hot plug indication LED's.

5. The computer system of claim 1 wherein the plurality of I/O busses auto-negotiate the data transfer rates of the adapter cards.

6. The computer system of claim 1 wherein the improvement engine comprises a programmable logic device.

7. The computer system of claim 1 wherein the plurality of I/O busses comprises I/O busses having more than one adapter card slot.

8. The computer system of claim 1 wherein the improvement engine comprises a programmable logic device that detects the specific I/O architecture of the computer system including which adapter card slots are on the same I/O bus and the data transfer rate capabilities of the I/O busses and the adapter cards.

9. The method of claim 1 further comprising a management console associated with the improvement engine, the management console operable to give details on a configuration problem when the adapter card configuration cannot be improved.

10. A method for improving the data transfer rate of adapter cards, the method comprising:

detecting the data transfer rates of a plurality of adapter cards;

detecting the transfer rate capabilities of a plurality of I/O busses;

determining when an adapter card limits a bus transfer rate;

indicating the location of a limiting adapter card; and

suggesting a less limiting adapter card configuration.

11. The method of claim 10 wherein suggesting a less limiting adapter card configuration comprises suggesting an improved adapter card slot location for the limiting adapter card.

12 The method of claim 10 wherein suggesting a less limiting adapter card configuration comprises recognizing that there is not an improved adapter card configuration, and not suggesting an improved adapter card slot location for the limiting adapter card.

13. The method of claim 12 further comprising opening a management console having configuration details when an improved adapter card configuration cannot be achieved.

14. The method of claim 10 wherein determining when an adapter card limits the bus transfer rate comprises analyzing and comparing the adapter card data transfer rates, the adapter card slots, and the bus transfer rate capabilities.

15. The method of claim 10 wherein suggesting a less limiting adapter card configuration comprises determining if a different adapter card slot location provides an improved configuration.

16. The method of claim 10 wherein detecting the transfer rate capabilities of a plurality of I/O busses comprises determining which adapter card slots are on the same I/O bus.

17. The method of claim 10 wherein indicating the location of the limiting adapter card comprises flashing an LED located proximate to the limiting adapter card.

18. The method of claim 11 wherein suggesting a less limiting adapter card configuration comprises flashing an LED located proximate to the improved adapter card slot location.

19. The method of claim 10 further comprising repeating the steps of determining when an adapter card limits a bus transfer rate, indicating the location of the limiting adapter card, and suggesting a less limiting adapter card configuration until either an improved configuration is achieved or an improved configuration is not possible.

20. A method for improving an adapter card configuration within a plurality of I/O busses, the method comprising:

adding an adapter card to the I/O busses;

initiating a performance check; and

reading indicators to ascertain if the adapter card configuration is limiting the data transfer rate.

21. The method of claim 20 wherein initiating a performance check comprises activating an optimization switch.

22. The method of claim 20 further comprising moving an adapter card from a non-optimal adapter card slot location to a suggested improved adapter card slot location to improve the adapter card configuration.

23. The method of claim 22 further comprising repeating the steps of initiating a performance check, reading indicators, and moving the adapter cards until an improved adapter card configuration is achieved or the indicators show that an improved adapter card configuration is not possible.

24. The method of claim 20 further comprising iteratively determining adapter card configuration improvement by checking one adapter card at a time.

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